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QUARTERLY TECHNICAL SUMMARY REPORT, JULY-SEPTEMBER 1972

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Teledyne Geotech

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understanding of the environment world

SEISMIC DATA LABORATORY QUARTERLY TECHNICAL SUMMARY REPORT JULY - SEPTEMBER 1972

18 OCTOBER 1972

Prepared for
AIR FORCE TECHNICAL APPLICATIONS CENTER
Washington, D.C.

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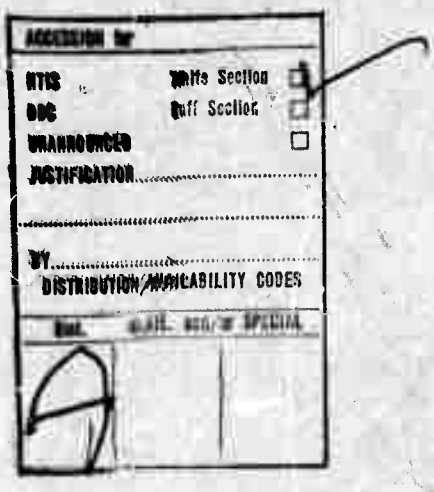
ALEXANDRIA LABORATORIES



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This report summarizes the work done by the SDL during the period July through September 1972, and primarily concerns the seismic research activities related to the detection and identification of nuclear explosions and earthquakes. The report also contains brief discussions of the support tasks and data services which were performed for other government contractors and for participants in the VELA-UNIFORM and PRIME ARGUS projects.

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TABLE OF CONTENTS

I. INTRODUCTION

This quarterly report summarizes the technical work, support effort, and data services completed during the period July through September 1972.

Reviews of technical reports completed during the reporting period are contained in Section II under descriptive headings. Section III is a summary of the support and service tasks performed for other government contractors and for VELA-UNIFORM and PRIME ARGUS participants.

Progress on analysis assignment 2-73 regarding an engineering study of seismic networks is reported in an addendum.

II. WORK COMPLETED

A. An Application of Ray Tracing to Seismic Event Location, No. 293

The objective of this study was to determine whether source modeling could improve teleseismic event locations near island arc structures, using models defined by available information about the underthrusting plates of these regions.

If one considers only the most reliably located events in the Aleutian Island arc, the teleseismic location shifts are all consistent with a simple plate model for the Aleutian-Alaskan region. This consistency indicates that source bias is the key factor in location errors for this region. Apparent unpredictability of the shifts for other events may stem from inaccurate knowledge of locations.

We describe a location method based on ray-tracing, using a crude source region plate model. In the

case of the Aleutian-Alaskan region, this method predicts all teleseismic locations should be shifted along the perpendicular to the Aleutian arc near the source location. The magnitude of the shift is estimated by a method which involves an initial hypocenter estimate, one calibration event anywhere along the island arc, and ray-tracing calculations of time residuals for sources near the estimated hypocenter. Our conclusion is that the technique shows promise of being able to remove location bias in island arc structures and should be investigated further.

B. Seismic Shear Waves as a Discriminant Between Earthquakes and Underground Nuclear Explosions, No. 295

The theoretical amplitude ratio of shear waves to compressional waves is computed using point double-couple representations of earthquakes. These ratios are compared to earthquake data from the LRSM and VELA observatory network. The earthquake data on shear-to-compressional ratios from this network is directly compared to that from NTS underground nuclear explosions. The shear-to-compressional ratio in the teleseismic distance range is found to be significantly greater for earthquakes than explosions, especially in the short-period band. However, use of shear wave data to discriminate between earthquakes and explosions is hampered by a high detection threshold.

C. Detection and Analysis of Multiple Seismic Events, No. 297

We have tested several methods of analyzing short-period seismic records to detect multiple events. The data

were from a pair of chemical explosions at a dam site near Alma Ata, recorded at the Mould Bay, Canada, seismic observatory. The methods evaluated included visual analysis of array beams, multichannel matched filtering, autocorrelation analysis, and cepstral analysis. For matched filtering we used the seismogram waveforms from a seismic event which occurred reasonably close to the Alma Ata site.

Measurements using the spectra or the cepstra appear to be more accurate in determining the delay time between the two events. The analysis methods discussed here are generally in good agreement with the announced time between the explosions, and their yield ratio.

III. SUPPORT AND SERVICE TASKS

In addition to the research studies discussed above the SDL completed the following support and service tasks:

A. Data Cataloging, Classifying and Retrieval

The library consists of seismograph data from the LRSM sites, the observatories LASA, TFO, UBO, WMO, BMO, CPO and additional data from other sources. The corresponding operational logs are also included in the library.

At the end of September 1972, the library contained approximately:

32,929	analog magnetic tapes
20,887	digitized seismograms
5,665	digital magnetic tapes.

The library also contains seismographic data on 16 mm and

35 mm film. Those are commonly from simultaneous recording of tape and film data at the observatories and the LRSM sites.

The following categories of digital tapes are in the library:

281	UBO multiplexed
1,199	LASA multiplexed
683	TFO long period (DGRADAS tapes)
595	TFO short period (ASDAS tapes)
2,014	Library tapes (A/D and D/D conversions)
984	Permanent Save Tapes
1,663	Operations tapes (scratch, save, etc.)

The analog tape library contains:

9,232	Compressed tapes
488	Composites
17,412	Tapes saved as recorded (not compressed)
6,228	Tapes scheduled for compression as time permits.

As a result of compression 559 analog tapes are available for return to field operations.

B. Equipment Modifications

The CRT display for the PDP computer was modified to increase its usage of memory from 16 to 32K. The card reader was placed on the data channel instead of the transfer channel reducing the CPU time required to read a card by a

factor of 80. Modifications to the SDT system will be reported in a separate document.

C. Maintain and Operate Equipment

Minor problems in the TU10 Tape Drive, the teletype, and the card reader were corrected.

D. Digital Programming

A loose-leaf binder with program writeups of significant computer programs is being delivered together with this quarterly to VSC.

Programs have been written and checked out for the PDP-15/50 which will create A/D tapes either in SAAC subset form suitable for input to the 360/44, or in a form suitable for re-entry into the PDP-15/50. Programs have also been written to read Lincoln Lab data tapes and to create tapes of a suitable format for Alexandria Labs.

The BOSS-15 system is on-line. The VT-15 Graphics display subsystem seems to be working well.

Progress on the SDT will be reported in a separate document.

E. VELA and PRIME ARGUS Data Copies

During the past year SDL supplied data or computer services to the following:

Air Force Cambridge Research Laboratory
Air Force Office of Scientific Research
Brown University
California Institute of Technology
Commonwealth of Australia, Dept. of Natl. Development

Dept. of Energy, Mines, and Resources, Ottawa, Canada
General Atronics Corporation
IBM
Institute of Geophysics, Victoria University
Lawrence Livermore Laboratory
Los Alamos Scientific Laboratories
MIT, Lincoln Laboratory
Pennsylvania State University
Royal Norwegian Council for Scientific and Industrial Research
Southern Methodist University
University of Alaska
University of Edinburgh
Universite Louis Pasteur
University of Utrecht
University of Washington at Seattle
University of Wisconsin
U.S. Arms Control and Disarmament Agency
U.S. Department of Commerce, National Oceanic and Atmospheric Admin.

F. Analog Field Tape Supply

No analog tapes were returned to the field during September 1972.

G. Array Data Service

LASA weekly event summaries through 23 September 1972, were distributed to 32 addressees approved by the government.